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METALS AND ALLOYS.

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Of the 106 elements in the periodic table about 90 are classified as metals. Some elements such as oxygen, chlorine, hydrogen and the inert gases are considered to be non-metallic. There is, however, a group of elements including carbon, sulphur, silicon and phosphorus, which is intermediate between metals and non-metals. They are called metalloids. Metals are the most important structural materials of our days. There are chemical elements possessing lustre hardness, malleability, electrical and heat conductivity.

The most widely used metallic elements are iron, copper, lead, zinc, aluminium, tin, nickel and magnesium. Some of them are used extensively in the pure state but by far the largest amount is consumed in the form of alloys.

Metals applied for industrial purposes are called «engineering metals››. The commercial importance with one another to produce substances having a wide range of properties which may not be attained with pure metals alone. The engineer must know such properties of a metal as strength, hardness and elasticity. These depend on the chemical composition and the physical structure of the material. Such characteristics as specific heat, thermal conductivity, coefficient of expension, colour, strength and hardness are known to be the physical properties of material. The physical properties describing the behavior of materials under mechanical usage such as strength, hardness, machinability and ductility are called the mechanical properties.

Metals are usually divided into two groups, that of ferrous or iron-bearing rentals including copper, lead, zinc, aluminium, tin, nickel, etc. Ferrous metals consist of iron combined with carbon, silicon, phosphorus and other elements. Carbon is the most important of all elements present in ferrous alloys. Ferrous metals are used in industry in two general forms: steel and cast iron which differ in the quantity of carbon content. Non-ferrous metals are generally more expensive per pound than ferrous metals. Their characteristics are high electrical and heat conductivity, high corrosion resistance, non-magnetic qualities light weight and ease of fabrication. Sometimes non-ferrous metals are applied in the pure state, for example, lead is used for lining pipes and coating electrical cables; copper is utilized as wires, aluminium is used for making different light weight objects.

Pure metals are comparatively seldom used in industry. In most cases some alloying element is added to metals, and thus alloys are formed. An alloy is a combination of elements exhibiting the properties of a metal. It can also be defined as a substance formed by the solidification of a metallic solution. Alloys consist of two or more metals or metals and metalloids. Each constituent of an alloy is called a component. Alloys may be binary (two component), ternary (three component), etc. The ability of various metals to form alloys differs greatly. If metals do not dissolve in each other when they are molten they will not form an alloy when solid. An alloy looks like a homogeneous mixture of metals but under the microscope it is seen as an aggregation of crystals, these crystals being sometimes different from one another in chemical composition as well as in size, hardness and other properties. Some metals do not dissolve in each other when liquid, for example, molten lead and aluminium separate into two liquid layers, each containing only a trace of the other metal.

Aluminium when molten is insoluble in many other metals, such as sodium, potassium, cadmium. Bismuth and iron tre insoluble in each other when liquid. Molten lead will dissolve only a small amount of molten zinc, molten copper will dissolve only a little of molten iron and molten iron will dissolve only a little copper. If it were not for this fact, it might be possible to form some very valuable alloys of iron and copper, these two metals being useful and common.

In the liquid state alloys are entirely homogeneous but when an alloy is transformed from the liquid to the solid state non- homogeneity may appear, i.e. several solid phases are formed.

The change from the liquid to the solid state is very important in determining the properties of an alloy.